

BIOLOGICAL NOTES ON *SINOXYLON SUDANICUM*
LESNE AND ITS PARASITES IN S. INDIA.

BY

P. N. KRISHNA AYYAR AND V. MARGABANDHU,
Agricultural Research Institute, Coimbatore.

(With two graphs.)

INTRODUCTION.

In November 1935, in the course of an investigation into the possibilities of the biological control of *Pempheres affinis* Fst., the senior author had occasion to collect a few Bostrychid adults from tunnels especially bored into the stems of green cambodia cotton plants taken directly from the field. These were sent to the Imperial Institute of Entomology, London and were identified as *Sinoxylon sudanicum* Lesne. Little did the author suspect, at the time, that the insect would have such an intimate bearing on the problem in hand, as revealed by subsequent studies.

Bostrychids as a group appear to have attracted little attention in S. India in the field of Agricultural Entomology. They are known to be of great economic importance as borers of various kinds of wood. Apart from brief references to their biology and habits from time to time by Forest Entomologists, comparatively little is still known or has been published on the subject. Although special studies on this economic group would, therefore, be highly desirable, it has not been possible for the writer to do so. But some useful observations in the course of other studies have been made from time to time during the last four or five years on one of the economic species namely *Sinoxylon sudanicum* Lesne and it is the purpose of this paper to present a connected account of the same, so as to supplement what is already known of the species.

REVIEW OF PREVIOUS KNOWLEDGE

Sinoxylon sudanicum was first described by Lesne (1896) and further in 1906. In spite of its common occurrence in S. India, it seems that little is known of its biology or habits. The first record of the species in South India appears to be by Fletcher (1914) who says that its life history is not known. He suggests its probable occurrence in the whole of South India particularising Bellary, Coimbatore and Chingleput. According to him it attacks dry stems of Agathi, dead Cambodia stalks, and almost any dry soft wood. Gardner (1933) has described and figured the mature grub. The latest reference is by Beeson and Bhatia (1936) who record it as widely distributed in Bengal, Bihar, Bombay, Central Provinces, Madras, Mysore, Punjab, Sindh, United Provinces, and N. Africa. Their list of host plants includes *Acacia* sp., *Albizzia* sp., *Balanites roxburghii*, Bamboo, *Butea frondosa*, *Casuarina* sp., *Dalbergia* sp., *Ficus palmata*, *Mallotus* sp., *Mangifera*

indica, *Pongamia glabra*, *Prosopis spicigera*, *Quercus* sp., *Rhus parviflora*, *Shorea robusta*, *Terminatia tomentosa*, and several unidentified woods. They also record that the emergence period is prolonged, 40% of the population emerging in May and 43% in April, June and July with a subsidiary peak at the end of July and they, in fact, make out mainly two broods in a year.

ECONOMIC STATUS OF THE SPECIES IN S. INDIA.

The discovery of this insect as a useful and abundant alternate host of an important Braconid parasite *Spatnius critolaus* of the cotton stem weevil served to bring it into prominence in S. India. Its presence is a common phenomenon in the weakened or wilting green plants of cambodia. Almost every wilting plant in the field may show its tunnelling, and this becomes prominent in the season October to January when considerable numbers of cotton plants are killed or weakened by stem weevil attack. At the close of the cotton season, the cotton plants pulled out and stacked from April to August display heavy infestation which serves to bring about a continuity in breeding throughout the year. It may be evident, therefore, that the conditions of cambodia cultivation provide exceptionally favourable facilities for breeding and multiplication. It is no wonder, then, that the insect, in virtue of its habits and abundance, constitutes an excellent alternate host for an important stem weevil parasite.

Description. The adults are robust beetles of a deep brown to dark colour, varying in length from $3\frac{1}{2}$ mm. to 5 mm. As is the case with most bostrychids the body is of a cylindrical form.

The sexes are so similar that it is very difficult to distinguish the males from the females except by the smaller size of the former. The only character by which these may be distinguished lies in the comparative length of the silky bands on the internal aspect of the posterior tarsi. These bands appear to be somewhat longer in the male than in the female.

Numerous counts of daily collections have been made to ascertain the proportion of the sexes, and it has been observed that the females invariably outnumber the males.

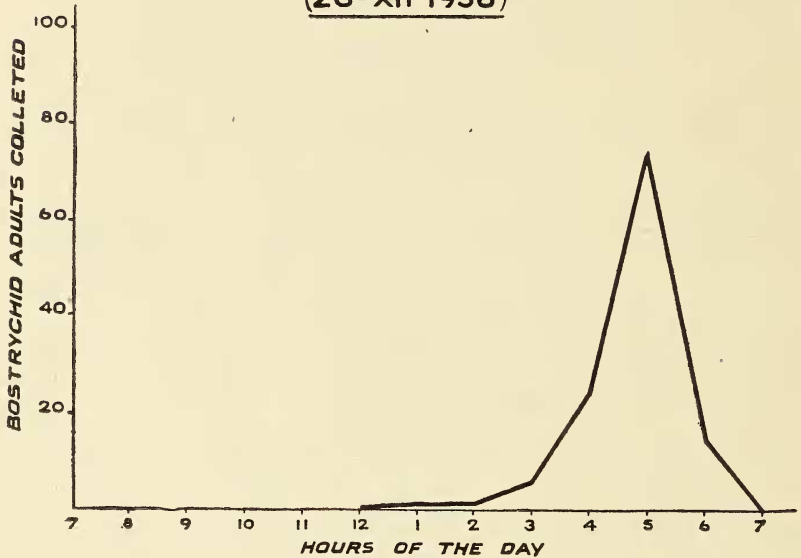
ACTIVITY.

The beetles do not appear to be active within the cages but for the incessant and untiring tunnelling of the stalks. On sunny warm days, particularly late in the afternoon the adults can be seen flying from a distance and dashing against large wire gauze out-door cages filled with cotton stalks. Their activity appears to be governed by temperature and sunlight. They seem to possess great powers of flight although they seldom take to their wings even when exposed indoors, but have often been seen to crawl from stalk to stalk. Their powers of flight are of great importance for dispersal and spread of infestation. Their activities are best observed near large out-door wire gauze cages containing cambodia cotton stalks. They are seen flying from afar and fluttering about the cages. After dashing against the cages they can often be seen rolling on the ground beside the cages. Detailed observations have been made continuously for several months to determine the time of their greatest activity. Records of daily collections in relation to the prevailing weather conditions have been maintained for the months of June-July 1936, September-October 1936, December 1936 and January 1937 (vide table and curve appended) which will afford an insight into their behaviour during different hours of the day.

The hours of greatest activity as seen from the maximum hourly catches appear to be between 4 and 5 p.m. in the evening. The adults are seldom seen in the forenoon or after 7 p.m. Their activity commences by about 2 p.m. and

attains the maximum by about 5 p.m. after which a definite decline can be noted. Bright sunshine seems to be an important factor inducing flight and activity. The

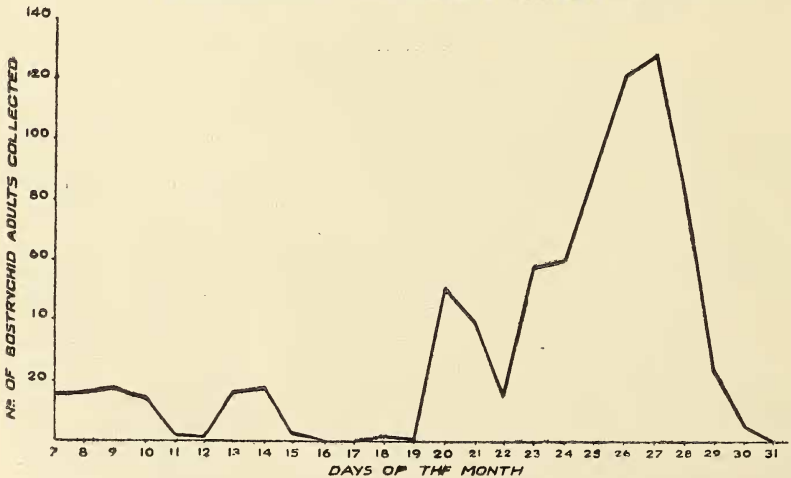
**BOSTRYCHID EMERGENCE
DURING DIFFERENT HOURS OF THE DAY
(26-XII-1936)**



catches during dull weather have been extremely poor. The adults boring into stalks inside cages also display the same tendency on bright sunny days; the adults may be seen resting inside on the sides of the wire gauze cage facing the sun.

The daily collections made in December and January are depicted in the form of a curve.

BOSTRYCHID INCIDENCE IN 1936 DEC.



It may be seen that there are two peaks comparatively well marked, one of which is about the 19th and the other about the 27th of December. The adults

commenced to appear in larger numbers towards the end of the month; out of about 788 collected more than 500 were obtained during the last week of the month. In January there was a distinct fall in the collections as seen from the figure 314 for the whole month with a maximum of 38 per day as against 128 of the previous month.

NUMBER OF GENERATIONS.

Beeson and Bhatia (1937) have recorded only two broods in the year under North Indian conditions. Systematic observations for nearly four years have revealed the occurrence of four distinct broods under South Indian conditions. As judged from the length of life cycle under these conditions it is possible to have even five generations per year. The biggest is obtained in September-October when large quantities of pulled out cotton stalks of the previous season are available for breeding. Another generation which ranks second in magnitude occurs in December-January when plenty of suitable breeding material may be available in the shape of wilting cambodia plants. Others have been recorded in April-May and in July-August when systematic collections of adult beetles have been made.

CONGENIAL CONDITIONS FOR ATTACK.

It has been observed that normal cambodia plants in a vigorous state of growth are not suitable as hosts of *Sinoxylon*. The other extreme of unsuitability is reached in the case of plants completely dead and dried up which are also equally unattractive to the insects. Between these two extremes there is a wide range of conditions under which the host is suitable for successful attack. A number of trials to test the conditions of suitability was carried out. Two lots of cambodia plants—one consisting of 100 plants and another of 50 plants—pulled out from the field were exposed in the open near the cages on 7th December 1936 for attracting the beetles. On the third day of exposure the first attack by the beetle was observed and the material continued to be attacked for about 23 days, i.e. till the 28th of the month. No fresh attacks were observed after that date, though the observations were continued up to the 1st January of the next year.

Another lot of 82 uninfested plants pulled out on the 25th of November, was exposed on the 5th of December. The attack was observed on the 7th and it continued up to the 10th with no further attacks after that date. Several other lots of plants in different stages of wilting were also experimented with and the results were in conformity with previous observations. In one lot of plants with the bark peeled off, the infestations were not as numerous as in others. It will be seen from these trials that while certain conditions, particularly moisture contents, render plants suitable, no pathological conditions are needed to make the plants attractive.

NUMBER AND NATURE OF THE ATTACKS.

Detailed observations were made regarding the nature of infestations in a collection of 91 attacked plants. In 76 cases the entry was through nodes, in 7 cases the tunnelling was a little away from the nodes, and in 8 cases the entry was effected on or about the hypocotyl region. In some cases the beetle prefers to attack the cut ends of stalks. The insect also bores into leading side branches of plants. Regarding the number of attacks, out of 93 plants examined, 86 showed single attacks, the remainder having double attacks. In all cases of double attacks the tunnels were seen bored near each other indicating that males of the species make separate entrance holes only occasionally.

THE COURSE OF TUNNELLING.

The female beetle commences its operations by gnawing a neat circular aperture often through the bark or rarely at cut ends, and throws out heaps of saw dust. The tunnel may be at a varying angle from the surface. This entrance tunnel descends deep into the stem and enlarges into a neat roomy chamber known as the pairing chamber from which two or three narrower tunnels branch off generally encircling the stem the outer surfaces of which

are covered only by the thin bark. Slight deviations from this typical example have been encountered and these are illustrated in the figures attached. The male either utilises the same entrance aperture or constructs another close to it and communicating with the same. Not infrequently two females or even three have been observed in the pairing chamber. A bit of stem with one entrance aperture, a pairing chamber and two egg tunnels when examined revealed one dozen newly formed adults, six pupae, two full-grown larvae, six shrivelled up and dead larvae.

LIFE HISTORY.

Accurate determination of the life cycle with the rate of growth and duration of the several stages is extremely difficult in the case of these wood borers and therefore only approximate estimates of the same have been attempted.

IMMATURE STAGES.

Copulation has been noted on several occasions and has been seen to occur repeatedly, the process lasting roughly for a minute. Oviposition has not been observed nor has any estimate of the egg capacity been made. The female after eating out an egg tunnel round the stem, deposits its eggs at the bottom of the tunnel. Fertilised females caged with uninfested cotton stalks on 7-9-36 were examined on 17-9-36 and early stage grubs of approximately one or two days growth were observed in larval galleries. The construction of the egg chamber roughly occupies three to four days.

The grubs on hatching feed entirely on the wood and eat out larval galleries along the long axis of the stems. These galleries are filled with wood dust and excreta and the grubs themselves are seen buried in the dust. The egg and larval periods were roughly determined from data obtained as follows:—Fresh cotton stalks were caged with mated females and the material was examined at intervals to note the development of the grubs. The average period occupied varied between 30 and 32 days. The white curved grubs are somewhat active in their movements and go into pupation in a slightly enlarged neat chamber.

The pupa is white in colour and has a similar shape as the adult. The duration of the pupal stage was determined by the isolation of mature pupating grubs. The period occupies roughly 13 to 14 days.

LIFE CYCLE.

The data on entire life cycle are presented in the table below. Copulating pairs of adults were introduced into cages containing wilting cotton stalks and the first appearance of adults was recorded.

Adults introduced in cage on	Fresh adult obtained on	Life cycle in days
10-6-1936	8-8-1936	48 days
18-6-1936	8-8-1936	49 "
19-6-1936	10-8-1936	52 "
15-6-1936	27-7-1936	42 "
7-7-1936	21-8-1936	45 "
9-7-1936	1-9-1936	53 "
23-7-1936	9-9-1936	47 "

The life cycle period averaged about 48 days. The longevity of adults was tested by means of a few trials and this ranged from 4 to 23 days averaging 12.6 days.

HOST PLANTS.

With a view to test the comparative attraction exercised by different host plants a series of experiments was carried out. Stalks of other species of plants such as Acacia, Agathi and Mango were presented along with those of cotton in cages having Bostrychid adults. Among 30 stalks of Acacia only eight showed attacks. The adults apparently find it more difficult to tunnel into these than in cotton and do not traverse to any distance beyond their own body length. Agathi stalks supplied were left entirely untouched. Other trials where Agathi stalks alone were presented to the beetles yielded the same results. Mango stems showed better results in that three stalks out of 30 exposed displayed attacks. The beetles in this case seem to tunnel with greater ease than in Acacia. The adults appear to live for about a month when left with mango or cholam stalks. The striking preference to cambodia cotton shown by these insects was also apparent from various observations made in outdoor cages, wherein various other plants such as *Urena lobata*, country cottons, Bamboo, *Triumfetta* plants, several species of *Sida* and *Hibiscus* were kept on several occasions, the beetles were never observed to be attracted to such cages but were found fluttering about or resting on the cambodia cotton cage alone.

PARASITES.

Pediculoides ventricosus Newpt. :—This globular mite was a regular source of trouble in laboratory cages. These often suddenly appeared and devoured the immature stages of the beetles together with any parasite larvae attacking them.

Spathius critolaus Nixon :—This Braconid which is an important parasite of the grubs of the cotton stem weevil finds an excellent alternate host in these Bostrychids. The parasites confine their attentions to the advanced grubs of *Sinoxylon*. They attack mature grubs, also medium-sized grubs. Generally one egg, sometimes two eggs are placed externally on the grubs after their complete paralysation. The larva that hatches feeds, grows and consumes the entire contents of the host before cocooning in the host tunnel. The life cycle varies from 13 to 24 days. The males have a shorter life cycle than the females. The Bostrychid was, therefore, utilised as an alternate host for mass breeding of these parasites and five to six thousand parasites have been bred in the course of four years.

Various other species of parasites of the genus *Spathius*, particularly *Spathius* sp. near *labdacus*, and three undetermined chalcidoids have been observed to be parasitic on this host.

ACKNOWLEDGEMENTS.

The writer wishes to record his thanks to the assistants and fieldmen of the scheme who have all contributed to the collection of data presented in the paper. Particular mention has to be made of Mr. V. Margabandhu, who has taken great pains in making hourly collections during December 1936 and January 1937. The writer wishes to record his gratitude to the Indian Central Cotton Committee for making these studies possible by financing the Scheme and to the Government Entomologist and Cotton Specialist for affording facilities.

REFERENCES.

- Beeson, C. F. C. and Bhatia, B. M.—*Indian Forest Records*. Ent. series 2 : 223 (1936.)
 Fletcher, T. B.—*Some South Indian Insects* (1914).
 Gardner, J. C. M.—*Indian Forest Records*. 18 and 19 : 18 (1933.)
 Lefroy, H. M.—*Indian Insect Life* (1909).